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NOTES ON PLANORBIS II: P. BICARINATUS.

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PLANORBIS BICARINATUS Say. Pl. I, fig. 3.

1817. *Planorbis bicarinatus* Say, Nich. Encyc., pl. i, f. 4.

1822. *Helix angulata* Rackett, Lin. Tr. xiii, p. 42, pl. v, f. 1.

1834. *Planorbis engonatus* Conrad, N. F. W. Shells, sup. p. 8, pl. ix, f. 8.

1834.? *Planorbis antrosus* Conrad, Am. J. Sc. (1) xxv, p. 343.

1861.? *Planorbis lautus* H. Adams, Proc. Zool. Soc., Lond. 1861, p. 145.

This common and well-known species is one of the characteristic species of the fresh-water pulmonate fauna of eastern North America. It stands quite by itself, having, with the exception of the recently described *P. eucosmius* Bartsch from North Carolina, no closely related species in our fauna. It is the type of the subgenus *Helisoma* Swainson.

The shape of the shell is so well marked and distinctive that the synonymy is, as shown above, comparatively small. The *Helix angulata* of Rackett was, in all probability, described in entire ignorance of Say's previous description.

The type of Conrad's *P. engonatus* seems to have disappeared. According to Haldeman, who saw the "single original specimen," then in the collection of a Mr. Mason, it was a monstrosity. Conrad's figures are poor, but Haldeman's (Mon., pl. i, figs. 5 and 6), which are apparently excellent, confirm his opinion. It was found

at Albany, N. Y. Jay (Catalogue, 4th Ed., 1852, 10267) lists *P. bicarinatus* var. *engonatus* from Georgia. Through the courtesy of Mr. L. P. Gratacap, of the American Museum of Natural History, I have been able to examine these shells. Of the eight specimens in the set, one is a *P. campanulatus* Say, nearly but not quite mature; the remainder do not differ from the usual form of *bicarinatus*, except that the mature ones have a more or less expanded lip, and might well be referred to the form described by Haldeman as var. *angistomus*. None of them exhibit the peculiar flattening of the body whorl characteristic of *engonatus*. It seems probable that these specimens were referred to Conrad's species on account of the campanulate aperture.

What the *P. lautus* of H. Adams really is, is a matter of conjecture, which can be only definitely settled by reference to the type, if it is still in existence. In the meantime Tryon's supposition that it was a young specimen of his species seems probable enough to warrant its reference to *bicarinatus*, and thus eliminate it from the list of unknown American species.

Conrad's *P. antrosus* is no doubt a form of Say's species, and is quite probably the campanulate variety described by Haldeman as var. *angistomus*, under which it will be further discussed.

Say does not give the locality of the typical form in connection with his original description, but in describing the next species, *P. parrus*, mentions that both inhabited the Delaware, so that there is practically no doubt but that the types came from that river. The Delaware River form (pl. I, fig. 3) is the common manifestation of the species as it is usually found throughout the United States. Say's description, though brief, is excellent, and leaves little to be desired. An apparent typographical error occurs in the reprint from the 3d Ed. of Nicholson's Encyc., and probably in the original, as it is followed by Binney in his edition of Say's writings. The description as printed reads: "Shell subcarinate above, and beneath translucent." If the comma was placed after "beneath" instead of after "above," the sentence would be in better accord with the facts and in all probability with the intention of the author.

The name adopted by Say in his new species is almost a misnomer, as the typical form is really not carinated at all, either above or beneath. In both places it is rather a more or less acute angulation, and is never raised into a carina as, for instance, in *Valvata tricarinata* Say.

It is to be noted that Say, with his usual nice observation, describes the minute, revolving lines which are still characteristic of the Delaware River form, and which are not uncommon in specimens from other localities. In many instances, however, they are entirely lacking. Say described his species as sinistral. Without going into the question as to whether the shell is really sinistral or ultra-dextral, it may be said that with the exception of Say's original figures, and those of Call (Rep. Dept. Geol. Ind., 1899, p. 411, pl. viii, fig. 10), all the published illustrations known to the writer treat it as dextral, and in accordance with this practically universal custom the figures for the present paper have been drawn in that position. Those who prefer to consider the shell as sinistral have only to reverse the plate.

Considering the enormous extent of territory which it inhabits, and the diverse conditions of local environment to which it is subjected in different parts of its range, *P. bicarinatus* is, for a fresh-water pulmonate, remarkably uniform in its development, and comparatively few varietal forms have been described, and most of these have been distinguished within the last few years. Taking them in the order of their appearance, they are as follows:

I. Var. *UNICARINATUS* Hald., pl. I, figs. 6, 7 and 8.

Planorbis bicarinatus v. *unicarinatus* Haldeman, Monograph, p. 7 (1844).

"Whorls of the right (upper) side rounded; the carina on the left side revolves closely, so as to form a very narrow umbilicus, and the aperture is much extended towards the left." (Haldeman.)

Haldeman did not figure this form, but fortunately his type has been preserved in the collection of the Philadelphia Academy, and the figures here given have been drawn from it. It is very doubtful whether this form is entitled to varietal rank in the proper acceptance of the term. It will be observed from the figure that the inner whorls on the upper side are distinctly angulated, and that the angle does not wholly disappear until just before the aperture is reached. Such specimens are not uncommon in almost any large series, and all gradations from the bicarinate to the unicarinate form can be found in the same colony. It would seem, therefore, to be an individual rather than a racial characteristic. The form, however, is of interest as exhibiting the first step toward the purely ecarinate form described by Pilsbry as var. *aroostookensis*. The type came from the Schuylkill River.

II. Var. *ANGISTOMUS* Hald., pl. I, figs. 4 and 5.

Planorbis bicarinatus var. *angistoma* Haldeman, Mon., p. 7 (1844).

"Shell small, aperture campanulate, with the throat narrowed." (Haldeman.)

Haldeman did not figure this "variety," and his brief diagnosis copied above gives neither the dimensions of his type nor the locality from which it came. The type is not to be found in the collection of the Philadelphia Academy, and is apparently lost.

The claims of this form for varietal recognition are but little, if any, stronger than those of var. *unicarinatus*. In nearly all mature shells of *bicarinatus* there is a tendency, more or less developed, for the lip to become everted, and there is no difficulty in selecting a series showing all degrees of variation in this particular from the same locality. It is only occasionally that all the specimens in the colony are affected at the same time and to approximately the same degree. But sometimes this feature is very persistent; thus in the set from which the figure was selected not only are all the specimens (38) decidedly campanulate, but all previous lips were also campanulate, many of the specimens having two and some even three, the result being that the outline of the shell is in several instances greatly distorted. All the specimens from this locality were unusually flat, being very wide in proportion to their height. Similar specimens in all respects were collected in Bawbeese Lake, Hillsdale Co., Michigan, one of which, having a diameter of 16.5 mm., is only 4 mm. in height immediately in front of the aperture, the latter being 8 mm. in height. Some of these also are greatly distorted, showing apparently the effects of an unfavorable environment. Shells from Pine Island Lake, Kent Co., and Four Mile Lake, Chelsea, Mich., are somewhat similar, but the peculiar form is less strongly developed.

In many cases, no doubt, the sudden expansion of the lip is to be accounted for by unusually favorable food conditions at the time when the animal had really completed its normal growth; the consequent suddenly-acquired corpulency of the animal necessitating a special, rapid and expansive growth of the shell to accommodate its increased size. This seems to have been the case with the colony from which Figure 1 was taken. Up to maturity the shell was a typical *aroostookensis*, when suddenly the enormously expanded lip was developed. In this case, too, the whole colony was apparently

affected, at least the ten specimens which are now in my possession were all more or less, and that, too, without regard to size.

It seems quite probable that Conrad's *P. antrosus* from Randon's Creek, near Claiborne, Ala., is identical with this form. If so, and the form is worthy of varietal recognition, it would have priority over Haldeman's name.

Conrad never figured his species, and unfortunately gave no dimensions in his description. His specimens seem to have disappeared, and according to Tryon, in 1870, Conrad himself had forgotten all about it.

It is possible, however, that some of the original lot found their way to Europe, as the species was catalogued by Beck in 1837 as being in the collection of Prince Christian Frederick (Index Moll., p. 118, 1837). Whether these specimens are still in existence I do not know.

III. Var. *CORRUGATUS* Currier, pl. I, fig. 10.

Planorbis bicarinatus var. *corrugata* Currier, List of the Shell-bearing Mollusca of Michigan, p. 8, 1868.

This form was never described by Currier, who simply gives the locality as Perch Lake, Kent Co., Mich.

The figure is drawn from an authentic specimen (No. 3993, Coll. Walker), received from the late Dr. De Camp, who, in his Michigan Catalogue, described and figured several of Currier's species, but unfortunately neglected this one.

I have never seen but the single specimen from this locality, and do not know whether any more like it were found or not.

The form is peculiar in the strong, transverse plications, which extend entirely around the whorl, and are scarcely interrupted by the well-developed, superior and basal carinations; towards the aperture, however, they become less distinct. The revolving, incised lines are also deeply cut, and in this feature the form is similar to the var. *striatus* of Baker. It is altogether the most heavily sculptured form that I have seen. The specimen figured is rather small, measuring 9 mm. in diameter and 5 in height. The body whorl immediately in front of the aperture is 3 mm. in height. Individual specimens of var. *striatus* Baker from Long Lake, Grand Traverse Co.; Dead River, Ives' Lake, Mountain Lake, Little Lake and Howe Lake, Marquette Co.; Orchard Lake, Oakland Co., and Mud Lake, Montcalm Co., Michigan, and Gelot's Lake, New Sweden,

Me., exhibit a greater or less tendency to develop the transverse plications of this form, but none of them with anything like the strength or regularity of the specimen figured.

Similar specimens occur in the marl deposits at Bad Axe and other localities in Tuscola Co., Mich.

It is doubtful whether this form is entitled to rank as a variety. It is evidently an extreme development of the var. *striatus*, in which the transverse plication has been added to the revolving sculpture. If the name had not already appeared in the literature without description, and required explanation, I should hesitate to describe it as varietally distinct from *striatus*.

IV. Var. *PERCARINATUS* n. n., pl. I, fig. 12.

Planorbis bicarinatus major Walker, NAUT. VI, p. 136 (1893); *non* var. *major* of various species of various authors.

Shell very large for the species, thick and solid, dark horn-color tinged with purple; superior and basal carinæ elevated into a distinct keel, which is white; lip thickened, edged with brown, behind which externally is a broad, yellowish-white band, within banded by deep reddish-brown; lines of growth distinct, stronger and "puckered" around the carinæ; revolving lines very faint, not discernible except with a lens; aperture more or less expanded, sometimes distinctly campanulate, auriculate and distinctly modified by the extension of the carinæ to the lip.

The specimen figured measures 18.5 mm. in diameter and 10 mm. in height; height of body whorl in front of aperture 7.25 mm.; height of aperture 10.5 mm. A larger specimen, with a campanulate aperture, measures 19.75 mm. in diameter and 10.5 mm. in height.

Types (Nos. 3419 and 20074, Coll. Walker) from Crystal Lake, Benzie Co., Mich. Also from Pine Lake, Charlevoix Co., Mich. (Walker), and Rideau and Ottawa Rivers; Sparrow Lake, Simcoe Dist., Ontario, and Detroit Lake, Minn. (Pils.).

The original specimens, collected by the late Dr. M. L. Leach, were all dead shells, more or less bleached. The above description has been prepared from fresh specimens from the same locality collected by Dr. R. J. Kirkland, of Grand Rapids. Not in deference, for I think the rule an absurd one, but under the compulsion of the "International Code," I am forced to change the name of this very distinct variety and add another unnecessary synonym to the burden of systematic conchology.

V. Var. *AROOSTOOKENSIS* Pilsbry, pl. I, figs. 1 and 2.

Planorbis bicarinatus aroostookensis Pilsbry, NAUT. VIII, p. 115, 1875.

Shell having the spire and umbilicus very deep, the latter funnel-shaped, as in typical *bicarinatus*, but both upper and lower keels entirely obsolete or rounded off on the last whorl, which has the aspect of *P. trivolvus*. Surface minutely striated spirally, as in *P. bicarinatus*. Aperture less angular and less produced below than in *bicarinatus*, in consequence of the rounding of the whorls. Diameter 15 mm., alt. at aperture 7.5 mm. (Pilsbry).

Type locality, East Branch of Salmon Brook, Woodland, Aroostook Co., Maine (Pils.). Also Collins' Pond, Caribou River, Caribou, Aroostook Co., Me.; Charlevoix; Perch Lake, Kent Co.; Bessemer, Gogebec Co.; Fallams, Menominee Co., and Ispeming, Mich. (Walker).

Figure 2 represents the typical form of this variety, and is drawn from a topotype collected by Mr. O. O. Nylander. Figure 1 is the campanulate form, already referred to, which bears the same relation to typical *aroostookensis* that *angistomus* does to typical *bicarinatus*.

The Michigan specimens, especially those from the Upper Peninsula, are much smaller than the typical form, and in some examples there is a tendency to angulation on the whorls, but the large majority of the specimens are quite characteristic in the rounded, ecarinate form of the last whorl.

VI. Var. *STRIATUS* Baker.

Planorbis bicarinatus striatus Baker, NAUT. XV, p. 120 (1902); *Planorbis bicarinatus striatus* Baker, Trans. Acad. Sci., St. Louis, xvi, p. 9, pl. i, fig. 11 (1906).

In this form the microscopic, revolving sculpture commonly but not invariably present in the typical form is greatly intensified, and in the typical expression of the variety is quite conspicuous to the naked eye.

In the original description this sculpture is stated to consist of "raised spiral lines," while in the second paper quoted above it is said that "in some specimens the spiral lines are deeply incised." This incongruity is an apparent one only, and depends on whether the elevated or the depressed portions of the surface are wider or more conspicuous. Starting with the typical form, in which the revolving sculpture is either entirely wanting or very minute, it is

clear that the lines, when present, are incised. As the sculpture increases in strength, the intervals between the incised lines diminish, and when they become equal, the surface becomes typically striate and the revolving sculpture consists of incised or elevated lines, as the observer chooses to designate it.

Very rarely the surface is distinctly malleated, in which case there is a series of irregular, raised, revolving lines, which are quite different from the regular sculpture of var. *striatus*. The intensification of the spiral sculpture characteristic of this form seems to be peculiar to the northern states, as it has not been noticed from south of Mason and Dixon's Line. The most characteristic specimens come from the northern tier of states from Maine to Michigan.

The types were pleistocene fossils from Milwaukee, Wisconsin. It is a common form in Michigan, varying in size and proportion like typical *bicarinatus*. Specimens are also before me from the following localities: Square Lake; Rockville, Me.; Profile Lake, N. H.; Cedar Lake, N. Y.; Port Oram, N. J.; Gore's Bay, Manitowish, Id., Lake Huron, Algoma; Georgian Bay, Ontario.

VII. Var. *PORTAGENSI* Baker, pl. I, fig. 9.

Planorbis bicarinatus portagensis Baker, NAUT. XXII, p. 45 (1908).

This recently described and very striking form is characterized by its closely coiled whorls, deeply funicular upper and lower surfaces and acute carination; the umbilicus is comparatively narrow and deeply excavated; the aperture is large, auriculate, higher than wide, and acutely angled above and before; the lip is sharp and but slightly expanded. *HT 8.0 Diam 14.0*

Type locality, Portage Lake, Aroostook Co., Maine. Also Square Lake, Cross Lake and Second Lake, Aroostook Co., Me. (Walker); Meaches Lake, Hull, Quebec (Pils.).

The figure is drawn from a cotype kindly furnished by Mr. F. C. Baker. Specimens from Carp Lake, Emmet Co., and Betsey Lake, Benzie Co., Michigan, though not typical, may fairly be referred to this form. Immature examples, especially those from Betsey Lake, are almost identical with the immature Maine specimens, the whorls, perhaps, being more regularly rounded and lacking the decided flattening towards the base of the typical form. But the mature shells, though retaining the sharp carination above and below, are more inflated, and the aperture is wider and does not extend so far above and below the body whorl as in the typical form, being in shape and

position more like that of var. *percarinatus* (fig. 12). Two additional specimens from the original locality, submitted by Mr. Nylander, agree very exactly with the Michigan form.

Mr. Nylander writes in regard to the habits of this form: "I think the variety *portagensis* lives in comparatively deep water, say 25 feet or so as only a few good specimens have been collected and these have always been "dead" shells. The specimens from Cross Lake were dredged in 25 feet of water.

This raises a question as to whether the inflated form of this variety is not correlated with its habitat in deep water as suggested by Pilsbry in regard to the *Physa* and *Planorbis* from Lake Patzcuaro, Mexico (Proc. P. A. N. S., 1891, p. 324).

A parallel case is found in *Lymnæa mighelsi* W. G. Binn, which in Michigan, at least, lives in deep water a large part of the year (See NAUT., XIV, p. 8). In fifteen years' collecting at Pine Lake, Marquette Co., Mich., I have found this species only twice in shallow water and then in considerable numbers, but only for a few days. It seems likely that the peculiar form of *Physa lordi* Bd. is to be accounted for in the same way as in Michigan; at least, it is found only in the larger inland lakes. *Planorbis multivolvis* Case is also apparently a deep-water species (NAUT., XXI, p. 61).

VIII. Var. ROYALENSIS n. v., pl. I, fig. 11.

Shell thin, light greenish horn-color; superior carination prominent, rounded, not acute; basal carina very strong, not acute, but forming a heavy, rounded cord around the deep, funicular umbilicus; upper surface concave, but more or less flattened and not as deep as the umbilicus; sides flattened and narrowed towards the base and contracted just above the basal carina; lines of growth strong and distinct, the sides being longitudinally coarsely and irregularly striated; revolving sculpture strong and distinct; aperture triangular, the upper side very nearly straight and almost flat, meeting the lip at nearly a right angle; acutely angled below; lip thin, sharp, not expanded. Alt. 10, diam. 15; height of body whorl in front of aperture 5 mm.

Types (No. 29163, Coll. Walker) from Siskowit Lake, Isle Royale, Lake Superior, Michigan. Cotypes in the collection of the Philadelphia Academy.

About twenty specimens of this strongly characterized form were

collected by the University of Michigan expedition in 1905, and are very uniform in the peculiar features above described. *P. bicarinatus* was collected in 1904 and 1905 in a number of different localities in various parts of the island, but all such were quite typical in form.

The longitudinal sculpture of this form is unusually strong for the species, and reminds one of the heavy sculpture of *P. corpulentus* Say, but differs in being less regular and lacking the acute ridges of that species. *Royalensis* is nearer to *portagensis* than to any other form of *bicarinatus*, but differs in being wider and in the development and position of the superior carina, wider umbilicus, stronger basal carina and shape of the aperture.

(To be continued.)

RECENT FRESH-WATER FOSSILS FROM BRONX BOROUGH,
NEW YORK CITY.

BY EDWIN W. HUMPHREYS.

The shells here mentioned were found at what is now 171 St. and Morris Ave., Borough of the Bronx, New York City. The swamp which is situated at this point lies in a long, narrow, anticlinal valley which has been eroded in the Inwood Limestone. When the street, now known as Morris Ave., was filled in across the swamp, the peaty deposit, which had accumulated here, was forced up to heights of several feet on either side of it. This caused the peat to crack in all directions and revealed numerous pockets which were full of small shells. The shells were extremely abundant; so thickly were they heaped together that they could easily be scooped up with a garden trowel. From the manner in which they were found it would seem as if they had been gathered together by currents or eddies in the waters of the swamp. All of the shells were bleached to a chalky whiteness and were very fragile. The following species were found.

Amnicola limosa (Say) Hald. Shells of this species, though common, were not very abundant and were usually more or less injured.

Valvata tricarinata Say. These were exceedingly numerous, hundreds of them being heaped together in a single pocket. They were of all sizes, some being so small that they were lodged in the apertures of the larger ones. Evidently they represented individuals of all ages.

Physa heterostrophia Say. This species was rather scarce.

Planorbis bicarinatus Say. This form was also uncommon.